Construct validation of the Hazard Awareness Test (HAT)

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Abstract

The measurement of safety in job applicants is a primary concern to organisations. At present, current methods of assessing an individual's safety are limited to self-report and previous accident/incident history data which are subject to social desirability bias. To address this problem, the Hazard Awareness Test (HAT) was developed as an objective measure of safety. The main purpose of this study was to investigate whether the HAT is construct valid. In order to do this, 90 participants were included who differed on their health and safety expertise. All participants were required to complete the HAT followed by a self-report measure requesting biographical data, accident and incident history frequency information and responses to validated scales of safety motivation, safety knowledge, safety consciousness, risk taking, and career commitment. A between-groups experimental design was used to test four hypotheses regarding the influence that health and safety experience, workplace health and safety training, and independently sought health and safety education have on HAT performance. All hypotheses received support with the implications of the findings discussed within the context of the limitations of the research design.

Introduction

Overview of Health and Safety in New Zealand

Occupational health and safety is a primary concern to organisations around the world. According to the International Labour Office (ILO), the workplace is responsible for an estimated 3.13 million non-fatal accidents and 2.3 million deaths every year (ILO, 2015). Unfortunately, the working environment in New Zealand has contributed to these unfavourable statistics with the Department of Labour (2015) revealing that every year, thousands of New Zealanders are killed or injured at work, or suffer from a work-related disease. Specifically, WorkSafe New Zealand (2015) reported that the workplace has been responsible for more than 3000 accidents and 38 workplace fatalities in 2015. Although these statistics are alarming, research suggests that these statistics could be even greater with many organisations choosing to ignore practices surrounding accident reporting (Probst & Estrada, 2010).

Although total accident and fatality figures have slowly declined in the last 3 years (Worksafe NZ, 2015), the total recorded injuries as reported by industries remains at a level of major concern (Worksafe NZ, 2015). Statistics reveal that sectors including construction, agriculture, forestry, fishing and manufacturing are repeatedly contributing to this unfavourable toll. This comes as no surprise as employees working within high risk industries are required to operate in and out of highly perilous environments and are constantly within an arm's reach of an operational mishap. A split second lapse in judgement can be all that is required for an injury to occur ranging in cost from a minor scratch through to something far more permanent.

The Department of Labour (2015) describe the cost of workplace accidents and fatalities as either 'tangible' or 'intangible' and can occur from an individual, organisational and public viewpoint. From an individual perspective, these costs include direct income loss, ongoing medical visits, and losses related to lifestyle changes for both the individual and their family. Organisations suffer with damage to their public reputation, legal costs, lowered morale and production from employees, and the recruitment and training of new employees. From a public perspective, occupational accidents are responsible for significant economic costs. Figures from New Zealands' Accident Compensation Corporation (ACC) reveal that close to 700 million dollars was paid out for 303,000 active workplace related injury claims in a 12 month period ending in June 2015 (ACC, 2015). In order to combat these alarming statistics, the New Zealand government have implemented health and safety legislation which focuses on reducing the injuries and fatalities in the workplace.

Health and Safety Legislation

In the late 19th Century, Western countries identified the need to develop and implement legislation in order to create healthy working environments in an attempt to reduce the frequency of workplace injuries and fatalities (Occupational Safety and Health Service, 2000). Successive New Zealand governments have been actively promoting health and safety legislation for more than a century, beginning with the Factories Act which was introduced in the 1890s (New Zealand Legislation, 2015). Progressively, legislation was developed for more and more hazardous industries but the statutes tended to be prescriptive and narrowly focused on the particular hazard within that particular industry (DOL, 2015). This haphazard approach continued through into the 1970s until a review of all health and safety legislation was conducted by Lord Robens of the United Kingdom (DOL, 2015). This led to the publication of the 'Robens Report' which produced a single piece of legislation containing consistent polices and enforcement procedures across a range of industries. In the late 1980s, New Zealand conducted a similar process which culminated in the introduction of the Health and Safety in Employment Act (HSEA) 1992. The new legislation implemented the major findings of the ‘Robens Report’ whilst also positioning an additional emphasis on the need for employers to manage hazards within the workplace. The primary objective of the HESA 1992 is to ‘promote the prevention of harm to all persons at work and other persons in, or in the vicinity of, a place of work’ (DOL, 2015). The Act sets out to achieve this objective through promoting excellence in health and safety management by being systematic in defining hazards, the imposition of duties, the encouragement of volunteers, and the requirement of employee participation. The regulations within the HSEA 1992 are applicable to a wide range of working relationships within nearly all places of work (Worksafe NZ, 2015). The HSEA 1992 has been amended on one occasion to ensure it remains relevant to organisations. In 2002, the government passed the Health and Safety Amendment Act which focused on providing new means of increasing employee involvement, alternative enforcement measures, and also addressed issues concerning the Act’s coverage of work related stress. At present, New Zealand is undergoing further changes to workplace health and safety legislation. In August 2015, the Health and Safety Reform Bill passed through its third reading in parliament (DOL, 2015). The Bill looks to create a new Health and Safety at Work Act which will come into effect in April 2016. Despite legislative advancements, statistics on workplace accidents are still high, and clearly more needs to be done at the organisational level to improve workplace health and safety.

Health and Safety in the Workplace

Given the large proportion of time and effort that individuals devote to work, a strong focus for organisations should be on creating a healthy working environment allowing their employees to thrive and flourish (Tetrick & Peiró, 2016). Health and Safety concerns all employees working in environments ranging from construction sites through to an office setting. Regardless of the environment, safety should be a major concern for organisations as it is a source of substantial direct and indirect costs (Neal & Griffin, 2006).

Irrespective of the industry, the continued frequency of workplace accidents and fatalities has been linked to an organisations preoccupation with productivity which can often come at the expense of safety (Lamm, 2002). Lamm (2002) noted instances of individuals employed within management positions viewing health and safety initiatives as a 'cost' to their firm which has prevented these initiatives being conceptualised as having a broader relationship with improved employee performance and productivity. A similar view was noted by Maudgalya, Genaidy and Shell (2008) who found that some organisations, particularly smaller firms, viewed safety as an area where money is spent with little or no return.

The combination of a performance-oriented culture with little focus on health and safety can indirectly encourage the increased likelihood of unsafe behaviours occurring (Chmiel, 2008). Previous research has shown that unsafe behaviours commonly occur in organisations where speed and performance is prioritised over safety (Halbesleben, 2010; Mearns, Whitaker & Flin, 2003; Seo, 2005). An unsafe behaviour refers to employee behaviour which is in conflict with health and safety guidelines and generally occurs when individuals are taking short cuts and failing to follow instructions (Hoffman & Stetzer, 1996). Whilst performing an unsafe behaviour can result in an immediate negative outcome, some unsafe behaviours are performed without incident and have the potential to accumulate over time where the effects are not instantly recognised (Mullen, 2004). With incident reports of disasters like Chernobyl (1986) and Piper Alpha (1988) consistently revealing that unsafe behaviours are the leading cause of incidents, organisations are now tending to view initiatives towards workplace health and safety in a more positive manner.

Safety Management

With most on-the-job injuries occurring as a result of unsafe behaviours, organisations have paid considerable attention to establishing safety management systems (Didla, Mearns & Flin, 2009). A health and safety management system (SMS) is a formalised approach to health and safety by utilising a framework which aids the identification and control of health and safety risks (Hollnagel, 2014). Through routine monitoring, an organisation will measure the compliance against its own documented SMS, as well as legislative and regulatory compliance. The implementation of a well-designed and operated SMS has the potential to reduce accidents as well as improve the overall management processes of an organisation. A successfully implemented SMS will drive better safety performance and in turn, lead to a more profitable business (McKinnon, 2014).

According to McKinnon (2014), a successful SMS must incorporate 3 essential facets. The first is that the SMS must be a risk based system. That is, it must be aligned to the particular risks arising in the workplace. Given that the main objective of the system is a reduction in these risks, the system therefore must cater to the specific risks and hazards in the present environment as there is no 'one size fits all' solution. The second facet is that the system must be management led. A key factor in introducing a safety culture change is management initation, and therefore support by senior, line and frontline management will increase the likelihood of compliance from employees. The third and final facet is to ensure that the SMS is audit based. That is, it must be an audit driven system which calls for ongoing measurement against the standards and the quantification of the results. Rather than adopting a traditional focus on the number of injuries and fatalities, measurement should also include positive measures such as the number of environmental hazards eliminated and the number of safety suggestions made by employees.

Although popular, the use of safety management systems have drawn criticism given its narrow focus on technical factors such as the design of equipment, safety policies and programmes. There is argument that a stronger behaviour-oriented approach is required as it is becoming increasingly apparent that employee attitudes and behaviours govern how risks and hazards are identified in the workplace. Therefore organisations are beginning to shift their focus to understanding behaviours which contribute to their safety climate.

Safety Climate

The organisational climate is a multidimensional construct which encompasses a wide variety of individual evaluations of the working environment (James & James, 1989). It is a collective phenomenon consisting of the shared perceptions from members of an organisation about some of its relevant features such as rules, procedures, arrangements and shared habits (Schneider, Ehrhart & Macy, 2011). Given that climate is an important component of the social environment affecting individual and collective behaviours, influencing and shaping this climate could prove to be an effective intervention in promoting certain behaviours producing positive organisational outcomes (Tweedy, 2014).

Safety climate is a specific form of organisational climate which describes individual perceptions towards policies, procedures and practices relating to safety within the workplace (Neal, Griffin & Hart, 2000). The safety climate is a multi-dimensional construct however consensus over the factor structure of the concept varies. Zohar (1980) argues that safety climate includes 8 different dimensions involving perceptions of; importance of safety training, perceived effects of required work pace on safety, perceived status of safety committee, perceived status of safety officer, perceived effects of safe conduct on promotion, level of risk at work place, management attitudes towards safety, and effect of safe conduct on social status. In contrast, Dedobbeleer and Beland (1991) identified two factors which were management commitment to safety, and worker involvement in safety activities. Regardless, it has been suggested that safety climate be conceptualised as the extent to which employees believe safety is valued in the organisation as reflected in their perceptions of safety related policies, procedures and rewards (Griffin & Neal, 2000).

A focus on the measurement of 'lagging indicators' such as accident rates and fatalities as an indicator of the state of safety within an organisation has drawn criticism due to the reactive nature of this approach (Cooper & Phillips, 2004). Instead, a focus on 'leading indicators' of safety such as an organisations safety climate has recently emerged (Flin, Mearns, O'Connor & Bryden, 2000). A prospective view on safety suggests that an organisations' safety climate may operate as an antecedent to accidents and injuries (Neal & Griffin, 2002). This is consistent with Henning, Stufft, Payne and Bergman (2009) who suggest that safety climate is related to safety related behaviours, which are related to accidents and injuries.

Neal and Griffin (2002) conceptualise safety climate to be an antecedent to safety behaviour which consists of safety compliance and safety participation. Safety compliance refers to "the core activities that individuals need to carry out to maintain workplace safety" (Neal & Griffin, 2006 p.947). An example of this behaviour includes wearing personal protective equipment. Safety participation describes "behaviours that do not directly contribute to an individual's personal safety but that do help to develop an environment that supports safety" (Neal & Griffin, 2006 p.947). An example of this behaviour includes attending safety meetings. Clarke (2006) noted the positive relationship that safety climate has with safety compliance and safety participation, that is, a positive safety climate results in greater safety compliance and participative behaviours. Another important relationship identified by Clarke (2006) was the negative relationship between safety performance (compliance/participation) and accident involvement. That is, employees who view safety as a low priority within their organisation tend to demonstrate less safety compliance and participative behaviours and in turn, tend to have a higher involvement in adverse safety outcomes such as accidents and unsafe behaviours.

Neal and Griffin (2006) found that low levels of safety compliance and safety participation have a lagged effect on accidents within the workplace. Accidents and disasters are typically triggered by unintentional errors such as slips, lapses or mistakes, but they are generally made possible by pre-existing hazards that have made the system vulnerable to failure (Reason, 1990). These conditions are caused by employees engaging in unsafe behaviours and may not directly affect the individual carrying them out, but harbour conditions which can have a disastrous impact on other employees. Organisations that contain a greater proportion of Employees who fail to carry out safety behaviours should consequently accumulate a greater number of hazardous conditions and subsequent accidents and incidents (Neal & Griffin, 2006).

This highlights the importance of measuring hazard awareness during the early stages of recruitment and selection. It is important that an employee's hazard awareness mirrors that of the organisation in order for the safety climate to be successful. In order to achieve this, measurement should focus on the identification of hazards such as those associated with safety behaviour, the environment and equipment. As such the focus of this dissertation is on the psychometric properties of the Hazard Awareness Test (HAT) which has the potential to add significantly to workplace safety.

Safety Knowledge and Motivation

Available evidence suggests that safety knowledge (including knowledge of hazards) and safety motivation (including not engaging in hazardous behaviour) are critical determinants of individual differences in safety performance across a wide range of contexts

(Borman & Motowidlo, 1993; Campbell et al., 1993). Neal, Griffin and Hart (2000) argue that previous models of performance can be applied within the context of occupational health and safety, particularly in regards to an individual's safety performance (compliance/participation). The authors successfully proposed and defended their model which illustrated safety knowledge and motivation mediated the relationship between safety climate and safety performance. That is, safety performance can be determined by the safety knowledge and skills necessary to perform particular behaviours in combination with the motivation from individuals to perform these behaviours.

The importance of measuring safety knowledge and safety motivation during the recruitment stage is abundantly clear. Ensuring that safety knowledge and safety motivation are measured during the early stages of recruitment allows for the identification of individuals who may be at risk of having an accident. Individuals who do not score positively on measures of safety knowledge and motivation may pose a potential risk to not only themselves, but other employees working within the organisation. This presents a clear rationale for the development and use of safety instruments which can be implemented during the recruitment and selection phase. Surprisingly, a search of the literature, and an examination of the measures available in the recruitment market, suggests a number of serious problems with currently available measures.

Current Safety Measures used during Recruitment and Selection

It is important for organisations to focus on recruiting personnel who possess the knowledge, motivation, abilities and personality characteristics which are indicative of an individual's tendency towards safe behaviour in an occupational setting. This has resulted in a proliferation of safety assessment instruments (see Table 1) which typically use the extraction of self-report information, most commonly in the form of a questionnaire (Flin, Mearns, O’Connor & Bryden, 2000). Current safety measures commonly used by organisations during the recruitment process also include a review into the applicants’ historical data such as accident/incident involvement, and the implementation of safety oriented psychometric tests.

Organisations may use historical data such as accident/incident frequency reports during previous employment to predict the future safety of a job applicant. These reports have the potential to provide specific information detailing the series of events which have led to the occurrence of an accident involving that individual. The level of detail provided in these reports can help determine whether the accident occurred as a result of unsafe environmental conditions (e.g. defective tools or equipment) or substandard acts performed by the individual (e.g. non-use of personal protective equipment). However, given the numerous limitations surrounding these reports, a method more commonly used during recruitment is the implementation of psychometric testing.

Leading Australasian psychometric testing companies such as *OPRA Consulting Group* and *SHL Group Limited* are producing and distributing psychometric tools and measures which are orientated towards occupational health and safety. For example, in 2011 *OPRA Consulting Group* began distribution of the ‘Health and Safety Indicator’ (HSI), a psychometric tool designed to measure an individual’s general disposition towards workplace safety. The HSI is a combination of targeted personality and ability measures in one assessment which allows for the identification of health and safety risk factors (Opragroup, 2011). Specifically, the HSI claims to measure an individual’s ability such as attention to detail and understanding instructions as well as personality features including safety motivation, safety diligence, adherence to rules, openness to guidance, safety confidence and safety composure. Likewise, *SHL Group Limited* offer the ‘Workplace Safety Solution’ test which is designed for entry level positions to measure the behaviours and experiences that underlie successful and safe performance in the workplace (SHL, 2012). The tool measures an individual's general tendency to behave safely in the workplace using a variety of assessment types including personality traits, safety-related situational judgement and biodata.

Table 1.
Currently available Occupational Health and Safety Measures

Publisher	**Commercial Product**
Bay State Psychological Associates Inc.	Employee Reliability Inventory
Hogan Assessment Systems Inc.	Hogan Safe System
IPAT Inc.	Personnel Reaction Blank
OneTest Pty Ltd.	Onetest Work Safety Assessment (OWSA)
Orion System Inc.	Orion Pre Employment System PE3-SAFE
Psyfactors Pty Ltd.	Situational Safety Awareness Test
Psych Press	Work Safety Assessment
Psychological Consulting Ltd. (PCL)	Risk Type Compass
Psytech International Ltd.	Work Attitude Inventory (WAI)
RightPeople	RMP Safety Inventory
SHL Plc.	Workplace Safety Solution Test
Synergy Safety Systems	Safety Attitude Survey
Vangent (Pearson) Inc.	Employee Safety Inventory (ESI)
Vangent (Pearson) Inc.	Personnel Selection Inventory (PSI)
OPRA Consulting Group	Health and Safety Indicator (HSI)

Note: *Adapted from Paul Barrett's (2010) review of commercial products associated with the psychological assessment of safety attributes within prospective employees.*

Common Biases in the Recruitment and Selection Process

Previous research has focused on the occurrence of common biases during the recruitment and selection process for new employees into an organisation. Unfortunately, these biases apply to many if not all of the measures listed in Table 1. Thus while it appears that the area of safety measurement is well covered, it is in fact desperately in need of a bias free measure. Schlenker (1980) identifies common biases taking place within applicant letters, assessment centres and being particularly prevalent during the selection interview where the stakes and social interaction is high. In particular, authors have dedicated their efforts into producing publications detailing the frequency and influence that common biases such as social desirability and impression management can have during an organisations' recruitment and selection programme (Du Brin, 2010; Griffin & O'Leary, 2004)

Crowne and Marlowe (1964) define social desirability as 'the need for social approval and acceptance and belief that it can be attained by means of culturally acceptable and appropriate behaviours' (p. 109). It is a multi-component personality trait which encompasses two factors; self-deception and impression management (Fastame & Penna, 2012). Specifically, self-deception refers to the intentional process by which one attempts to convey an overly positive self-image whereas impression management refers to a goal-directed deception process where individuals regulate their answers to influence others in an attempt to establish a positive impression (Paulhus, 1984). With obvious benefits to job applicants, engagement in self-deception and impression management processes commonly filter their way into the selection process.

Self-deception during the selection process is the job applicant's tendency to respond to questions in a favourable light regardless of their true feelings about an issue or topic (Moorman & Podaskof, 1992). Zerbe and Paulhus (1987) argue that this tendency can be problematic during the selection process as it has the potential to bias the answers of the respondents which may mask relationships between two or more variables or produce 'spurious' relationships that do not really exist. In addition, responses affected by social desirability can change the mean level of the overall responses for a particular scale producing a skewed outcome of the respondent which is neither valid nor reliable (Podaskoff, MacKenzie & Lee, 2003).

The selection process is an ideal opportunity for job applicants to engage in impression management techniques. According to Tedeschi and Norman (1985), impression management can be divided into two types; assertive and defensive. Assertive impression management is typified by self-focused statements that indicate that the applicant possesses the necessary skills, abilities and positive characteristics to perform the job. It also includes attempts made by the applicant to develop rapport with the interviewer by trying to demonstrate that they share similar values and beliefs. In contrast, defensive impression management is concerned with the applicant perceiving the interviewer to be dissatisfied with an answer and therefore will attempt to 'repair' their self-image by further alterations to their answers given through the use of excuses, justifications or eluding the truth completely. Individuals who consciously engage in either self-deception or impression management processes tend to take longer to respond to questions pertaining to desirable/undesirable personality traits or behaviours as they put an emphasis on changing, shaping, managing and regulating their answers in order to avoid criticism and satisfy the need for social acceptance (Holtgraves, 2004; Johnson & Fendrich, 2002; DuBrin, 2010).

Given that common biases such as social desirability and impression management have been recorded as prevalent throughout the selection process, it is paramount that recruiters and employers have valid measures in place which can be used to combat these biases. This is of particular importance when recruiting for personnel within a high risk industry. If a job applicant applies socially desirable techniques to responses and information given, recruiters and employers are at a severe disadvantage in employing an individual who possesses the required level of safety orientation.

Limitations with Current Safety Measurement Methods

The current approaches used by organisations to measure workplace health and safety are clearly problematic as these approaches are littered with limitations affecting not only the validity of each approach, but subsequent recruitment decisions made when selecting an applicant.

The severe limitation when relying on the use of accident and incident data reports is that not all job applicants will have previous work experience. This is an issue that recruiters quite often face especially in situations where job applicants are entering the workforce straight out of a secondary or tertiary level educational institution. Additionally, even if the applicant can offer an accident report or incident frequency information, there is no guarantee the information is accurate. Furthermore, there is some evidence that individuals who have had a past accident (which might not have been the result of their behaviour) are in fact safer in the future. For example, studies by Laughery and Vaubel (1989) and Kouabenan (2002) both found positive correlations between safety behaviour and accident experience, suggesting that individuals become more cautious if they have an accident experience. There are also other issues such as reporting bias. As suggested by Sato and Kawahara (2011), accident rates and near misses are vastly underreported within organisations and therefore may not offer a fair reflection of an individual's safety history. Also, responses provided by an applicant in regards to their accident and incident history can be marred by common biases such as an applicant's motivation to make themselves appear as attractive as possible to an organisation. Therefore answers surrounding workplace health and safety are likely to be influenced by common biases such as social desirability and impression management.

Common biases such as social desirability and impression management can also occur in the respondents answers during psychometric testing due to the 'obviousness' of safety scales in what they are measuring (Fastame &Penna, 2012). For example, *OPRA Limited Groups'* HSI takes a measure of the applicant's awareness of the safety environment through asking the question, "Have you ever faced any crisis or emergencies in your workplace? How did you respond?" These type of questions posed by current psychometric testing companies increase the likelihood of error in a job applicants' responses. Keeping in mind, it is in the best interest of a job applicant to respond to questions such as these favourably, although perhaps not truthfully, as applicants are aware that a poor but maybe honest answer could result in them not being hired.

Given the limitations in the current available measures provided by psychometric testing companies, it is important that there is a measurement instrument which can be used to measure occupational health and safety which is appropriate for applicants without work experience, and not subject to common biases such as memory recall, social desirability and impression management. To meet this demand, the health and safety laboratory at the University of Canterbury, under the supervision of Associate Professor Christopher Burt has developed the Hazard Awareness Test (HAT).

Hazard Awareness Test: HAT

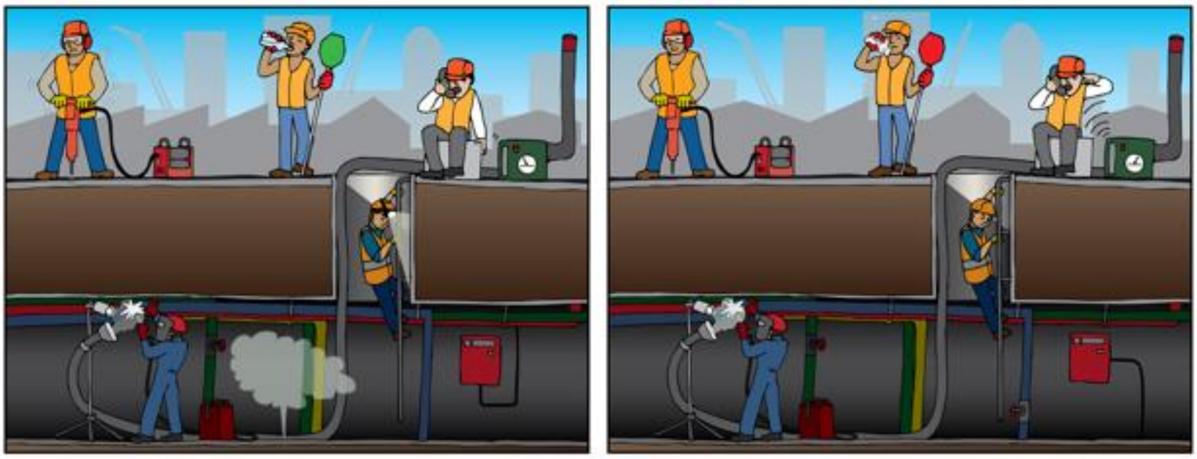
Given the limitations outlined in currently available occupational health and safety measures, a more objective method is required for employers and recruiters to obtain valid and reliable information when measuring a job applicant's safety knowledge. In order to address this need the Hazard Awareness Test (HAT) has been developed at the University of Canterbury (Burt, 2015; Hill, 2012; Shaw, 2012). A brief description of HAT is provided here, with more information in the method section and appendix materials. The HAT adopts the classic 'spot the difference' (see Figure 1) concept which involves the presentation of two otherwise similar images with minor differences between the first image (source image) and the second image (target image). Differences include alterations such as manipulations to colour, objects, the addition/removal of an object, shape adjustment and positional changes. Individuals are tasked with identifying a specific number of differences between the two images. The HAT involves the completion of ten spot the difference puzzles specifically designed to measure hazard awareness.

The ten spot the difference puzzles were illustrated by a paid artist who followed a brief developed by Associate Professor Christopher Burt of the University of Canterbury. The brief included detailed information on the safety hazards and unsafe behaviours to be included in each scene with an emphasis on the spatial relationship between each of the differences. The scenes depicted environments which covered 5 life domains enabling a broad scan of an individuals' hazard knowledge. The scenes included workshop safety, office safety, outdoor work safety, water safety and home-life safety. The brief specified that each of the 10 puzzles contained a total of 10 differences including 5 safety related differences and 5 neutral differences which were distributed over the entire scene. An example of a safety related difference would be the source image containing a worker wearing a hard hat in a dangerous working environment but wearing a sunhat instead in the corresponding target image. Likewise, an example of a neutral related difference would be a boy wearing a green sweater in the source image and wearing a blue sweater in the corresponding target image. It is not possible for the HAT puzzle images to be displayed anywhere within this dissertation given the need to maintain the confidentiality and security of the test. That is, the usefulness of a test is significantly reduced if it becomes publically available (Burke, 2009), and all dissertation are held electronically in the University Library.

The use of spot the difference puzzles in the HAT creates the potential to measure employee attitudes and behaviours in an objective manner. Specifically, puzzles scenes depicting hazards and unsafe behaviours across a number of life domains could prove valuable in measuring an individual's safety in an unbiased way. Individuals with more knowledge of safety hazards and unsafe behaviours should be able to find differences as they have a distinct advantage of knowing what to look for. For example, individuals with safety knowledge should identify a difference object such as inappropriate footwear (jandals) being worn within a busy workshop setting as it violates occupational health and safety standards.

Figure 1.

Example of a spot the difference puzzle containing 10 differences between the source image and the target image.



Note: *This image was initially developed for the HAT but was one of several which was removed during initial development work based on the aim of the final test including 10 images.*

Previous HAT Studies

Development of the HAT began with two dissertations conducted at the University of Canterbury, New Zealand (Hill, 2012; Shaw, 2012) with the purpose of both studies to examine psychometric aspects of the HAT. Hill (2012) conducted a study using the HAT on 60 undergraduate students at the University of Canterbury. HAT performance was correlated with their reported number of work related injuries and incidents. The results indicated evidence of criterion related validity, with participants who performed well on the HAT, reporting fewer work related injuries that required medical attention, fewer minor injuries, and fewer near hit incidents. A between group comparison was conducted to further examine the relationship between HAT scores and safety. This involved dividing the participants into two groups; those who reported having at least one workplace accident, *accident group*, and those who didn't report having a workplace accident, *non-accident group*. Comparison of the means indicated a significant difference between the two groups with the *non-accident group* identifying on average a significantly larger number of safety differences on the HAT. The total time spent attempting to complete the HAT took an average of 16.7 minutes with no significant differences between genders. The mean total safety differences found was 42.10 with no significant differences between genders.

Shaw (2012) conducted a study using the HAT on 30 male construction workers. After completing the HAT, participants rated their safety motivation using a 4 item scale developed by Neal, Griffin and Hart (2000). The participants immediate work supervisor also responded to 4 incident and injury questions about the participant. Significant correlations between HAT performance and safety motivation were found indicating that participants who found more safety differences on the HAT also rated their safety motivation higher. The immediate supervisors responses to the participant's accident/incident history were used to divide the groups into two; an *accident group* (occurrence of at least 1 workplace accident or injury) and a *non-accident group* (no reported accidents or injuries). A comparison of means between the groups revealed that the non-accident group, on average found more safety differences than the accident group. However, mean differences between the two groups were not statistically significant. The average time taken attempting to complete the HAT for all participants was 35.55 minutes, an increase of more than double found in the study conducted by Hill (2012). However this may be due to the fact that participants were given time off work to complete the study. On average, a total of 45.66 safety hazards was found, a greater number than the participants used in the study conducted by Hill (2012).

Current Study

In order for the proposed Hazard Awareness Test (HAT) to be deemed a solution to the problematic subjective nature of current commercial tools used by organisations, it must contain construct validity. That is, it must actually measure what it purports to be measuring which in this particular case is the awareness of hazards and unsafe behaviour. The current study looks to investigate the construct validity of the HAT through analysis of HAT performance and self-reported data between three groups. Each group has been determined by the quasi-variable health and safety expertise (HSE) which has led to the formation of a *low HSE group*, *medium HSE group* and *high HSE group*. The *low HSE group* comprises of tertiary undergraduate students who have limited or no experience working within risky jobs, limited or no health and safety training, and limited or no health and safety education, thus are relatively naïve in terms of safety. The *medium HSE group* comprises of individuals currently employed within a high risk industry and who therefore have experience confronting hazards on a daily basis, and have received health and safety training. The *high HSE group* comprises of individuals currently occupying a health and safety role within an organisation (e.g. safety manager) and are therefore in a position where it is paramount to understand and manage risks and hazards in different environments.

Given that the study operates on the rationale that the three groups will significantly differ in their experience, training and education in occupational health and safety, it is expected that this will result in differences in their attitudes and behaviours towards safety, and their speed and knowledge in the identification of hazards. Thus overall if the HAT is a construct valid test it should be able to identify between-group differences. The research also used information about the individuals sampled in the three groups to form other groupings (e.g. those with and without safety training) which were used to test several of the hypothesis outlined below.

Hypothesis 1: Participants in the High HSE group will perform better on the HAT than the Medium HSE group and Low HSE group through:

a) The identification of a greater number of safety differences found
b) Less total time recorded attempting to complete the measure

Hypothesis 2: Participants who have received workplace health and safety training will perform better on the HAT than participants without workplace health and safety training through:

a) The identification of a greater number of safety differences found
b) Less total time recorded attempting to complete the measure

Hypothesis 3: Participants who have received health and safety education independent from their workplace will perform better on the HAT than participants without health and safety education through:

a) The identification of a greater number of safety differences found
b) Less total time recorded attempting to complete the measure

Hypothesis 4: Across the entire sample, HAT performance metrics; total number of safety differences found, and the total time taken to complete the HAT, should significantly correlate with self-reported data on work experience, work safety experience, and health and safety training and education.

Method

Design

A between-groups design was used for the purpose of this study. Three groups were involved in the study which included a low health and safety expertise group comprising of tertiary undergraduate students, a medium health and safety expertise group comprising of high risk industry workers, and a high health and safety expertise group comprising of health and safety practitioners. The study required the completion of two tasks by all participants. The first task required participants to complete the Hazard Awareness Test (HAT), a test comprising of 10 spot the difference puzzles performed on a laptop provided by the researcher. The second task required participants to complete a specifically designed participant self-report measure which involved a series of questions with items concerning biographical data and a measure of their accident history. A selection from five validated scales measuring safety knowledge, safety motivation, safety consciousness, risk taking and career commitment have also been included in the self-report measure depending on its suitability to the particular group

Recruitment

The recruitment of participants was dependent on the group they were in. Participants in the *low HSE group* were recruited through access to the 'Psyc105/106 Participant Pool' granted by the Department of Psychology Research Committee at the University of Canterbury. The participant pool contained currently enrolled psychology undergraduate students who were required to participate for 1 hour in an approved academic study in order to receive course credit. A brief advertisement (see Appendix A) outlining the specifics of the study was presented using the online recruiting system, Sonar 6 where students would register for a mutually agreed time. Tertiary students were chosen to represent this group due to the likelihood of their relative naivety towards workplace health and safety, thus less work experience, and training and education in the identification of safety hazards.

Participants in the *medium HSE group* were recruited through an email (see Appendix B) which was distributed to industries which have been reported as statistically high in workplace accidents and fatalities (construction n=14, manufacturing n= 9, agriculture n= 7). In the email it was made clear to the organisation that their participation was voluntary with no obligation to take part in the study. They were informed that they could, at any time, withdraw from the study without penalty. As an incentive, participants were rewarded with a $10 Motor Transportation Association (MTA) voucher redeemable at any one of the 4000 registered MTA members nationwide. High risk industry workers were chosen to represent this group given their work experience, and potential safety training and education provided to them as a result of working within an industry with an associated level of safety risk.

Participants in the *high HSE group* were recruited through an email (see Appendix C) which was distributed to organisations who employed a health and safety manager. In the email it was made clear to the organisation that their participation was voluntary with no obligation to take part in the study and they were informed that they could withdraw from the study without penalty. Participation was rewarded with a $10 MTA voucher as an incentive. Health and safety managers were chosen to represent this group given their work role, work experience, and the training and education required in order to work within a position responsible for the health and safety of a number of employees within different working environments.

Participants

Overall, there was a total of 90 participants involved in the study. The demographic information of each group is summarised in Table 2.

Table 2.

Demographic Information of Participants by Group

	Low HSE Group	Medium HSE Group	High HSE Group
Males	14	16	17
Females	16	14	13
Mean Age (SD)	20.8 (6.95)	26.1 (9.31)	41.0 (6.95)
Range of Age (SD)	18-53	18-58	24-56
N	30	30	30

Materials

Task 1: Hazard Awareness Test (HAT)

The HAT was loaded onto the computer software programme, E Prime which was uploaded onto an Acer Aspire E1-571 Laptop with a 15.6 inch display screen. When opening the programme, instructions (see Appendix D) were presented on the screen which primarily outlined how to correctly perform the task and served as a reminder of the right to withdraw from the study without penalty. During the task, two almost identical images were presented horizontally side by side. All images were displayed in colour at a resolution of 95 dpi and to the dimensions of 1680 pixels wide and 930 pixels in height. The two images were positioned in the centre of the screen with a white border above and below each image. Other information on the screen included the remaining number of clicks the participant had which was positioned alongside a 'give up' button. The images remained on screen until either all 10 clicks had been used or the give up button was clicked. The computer programme randomised the order of the puzzle sequence. When programming the puzzles, a square vector was drawn around each individual difference. In order for the programme to register a correctly identified difference, a click was required within this vector with clicks outside the vector, even slightly, registered as error. Vectors were not visible to participants unless correctly identified, in which case the green outline of the vector appeared to serve as a notification that the difference was correct and to prevent participants from re-clicking the difference. Each vector was coded with a numerical value (1 through 10) which allowed for the dependent variables to be accurately measured.

Dependent Variables

Total number of safety differences found

The total number of safety differences variable was calculated through the differentiation between safety related and neutral differences. The summation of safety differences found across the 10 scenes provided a score out of 50.

Time spent attempting to complete the puzzles

The time variable refers to the amount of time taken attempting to complete the 10 puzzles. Time was recorded sequentially following the click of the mouse. Specifically, time was recorded at each mouse click resulting in a total of up to 10 recorded times. Given that it was recorded in a running fashion, the time for the 10^{th} click, or when the participant chose to give up, was the total time spent for that particular puzzle. The total time spent attempting to complete the HAT was calculated through the summation of all 10 puzzle times.

Task 2: Participant Self-Report Measure

Three participant self-report measures were created which catered to each of the three groups. Across all three groups, the same questions were asked concerning demographic information, work history, and accident/incident frequency information. The self-report measures varied in terms of the included scales of safety knowledge, safety motivation, safety consciousness, risk taking and career commitment. Only scales which were appropriate for their respective group were included. Table 3 provides a summary of the information requested in each measure.

Table 3.

A summary of the scales used in each groups' respective self-report measure

	Low HSE Group	Medium HSE Group	High HSE Group
Biographical Information	✓	✓	✓
Work History	✓	✓	✓
Accident and Incident Frequency	✓	✓	✓
Safety Motivation	✓	✓	✓
Safety Consciousness	✓	✓	✓
Risk Taking	✓	✓	✓
Safety Knowledge		✓	
Career Commitment			✓

Biographical Data and Work History

Biodata information requested the participant's age, gender, computer and console game usage. Given that the HAT was completed on a laptop using a computer mouse, previous gaming and computer experience was requested which could be used to explain differences on the HAT performance metrics. The participants work history was asked for including the number of paid jobs they have had, the number of jobs that had an associated risk, their current job title and tenure, tenure in their current industry and their health and safety training (provided by work or undertaken independently from work).

Accident and Incident Frequency measure

Items concerned with the frequency of accidents and incidents which occurred over an individual's entire life was measured using three items. These items required the participant to indicate the number of near miss incidents, minor injuries requiring medical attention, and lost time injuries they had experienced. The frequency ratings had the potential from 0 upwards.

Safety Motivation

Safety motivation was measured using a 4 item scale developed by Neal, Griffin and Hart (2000). This scale included items such as "*I believe that workplace health and safety is an important issue*" and "*I feel that it is important to maintain safety at all times*". All 4 items were measured on a 5 point likert scale which ranged from *(1)* strongly disagree to *(5)* strongly agree. A higher score on the scale indicates a stronger attitude towards safety motivation within the workplace. The original scale by Neal et al., (2000) reported a coefficient alpha of α=.93. Across all 90 participants, this study found the coefficient alpha to be .75.

Safety Consciousness

Safety Consciousness was measured using a 7 item scale developed by Westaby and Lee (2003). This scale included items such as "*I always take extra time to do things safely*" and "*I take a lot of time to do something safely even if it slows my performance*". All 7 items were measured on a 5 point likert scale which ranged from *(1)* strongly disagree to *(5)* strongly agree. A higher score on the scale indicates a stronger attitude towards behaving in a safety conscious way. The original scale by Westaby and Lee (2003) reported a coefficient alpha of α=.77. Across all 90 participants, this study found the coefficient alpha to be .83

Risk Taking

Risk taking was measured using a 5 item scale developed by Westaby and Lowe (2005). The scale included items such as "*I would rather take risks than be overly cautious*" and "*I love to take risks even when there is a small chance I could get hurt*". All 5 items were measured on a 5 point likert scale which ranged from *(1)* strongly disagree through to *(5)* strongly agree. A higher score on the scale indicates a stronger likelihood of participating in risk taking behaviours. The original scale by Westaby and Lowe (2005) reported an alpha coefficient of α= .85. Across all 90 participants, this study found a coefficient alpha of .76.

Safety Knowledge

Safety knowledge was measured using a 4 item scale developed by Neal, Griffin and Hart (2000). This scale included items such as "*I know how to maintain or improve workplace health and safety*" and "*I know how to perform my job in a safe manner*". All 4 items were measured on a 5 point likert scale which ranged from *(1)* strongly disagree to *(5)* strongly agree. A higher score suggested a higher degree of safety knowledge. The original scale by Neal et al., (2000) reported a coefficient alpha of α=.90. This scale was only used for the *medium HSE group*. The item wording was not suitable for the *low HSE group* who it was assumed were studying full time, nor was it suitable to the *high HSE group* who it was assumed were not working in a risky job – rather their job was to manage the risks of other employees. Across the *medium HSE group*, this study found a coefficient alpha of .84.

Career Commitment

Career commitment was measured using a 7 item scale developed by Blau (1989). The scale included items such as "*I definitely want a career for myself in this profession"* and "*I like this career too much to give it up".* All 7 items were measured on a 5 point likert scale which ranged from *(1)* strongly disagree through to *(5)* strongly agree. A higher score on the scale indicates a stronger level of commitment to an individuals' current occupation, profession and career. This scale was only used for the *high HSE group* as it was important to ascertain that the health and safety managers used in the study were appropriately representative of a group committed to workplace health and safety. In order to achieve this, scores on items 2, 3 and 6 were reverse coded. The original scale by Blau (1989) reported an alpha coefficient of α=.88. Across the *high HSE group*, this study found a coefficient alpha of.71.

Procedure

The collection of data occurred under the supervision of the researcher. All participants in the *low HSE group* were assessed within the Department of Psychology at the University of Canterbury, New Zealand. These participants were outside Psychology Room 439 as per the mutually agreed time previously arranged on Sonar 6. Participants were presented with an information sheet (see Appendix E) and a consent form (see Appendix F). Following their signing of the consent form, participants were guided to a computer desk where the HAT was ready to be used. When participants had finished the HAT, they were presented with the self-report measure (see Appendix G) which was completed in paper-pencil format. Participants who completed both parts of the study were credited with their 2% course credit. Before the participants left, they received a verbal and written debrief (see Appendix J) explaining the purpose of the study.

Participants in the *medium HSE group* and *high HSE group* were sent an email which provided an option to participate in the study either on the University Campus or at their workplace. It was paramount the environment was practical for laptop use and limited in noise exposure. Whilst the experimenter set up the HAT programme, the participants were presented with an information sheet (see Appendix E) and a consent form (see Appendix F). Following their signing of the consent form, participants completed the HAT and their respective self-report measures (see Appendix H and Appendix I) in paper-pencil format. Participants were then asked to sign a sheet indicating they had received their $10 MTA voucher incentive. All participants were issued with a verbal and written debrief (see Appendix J) outlining the purpose of the study and the researcher answered any questions.

Results

Data Preparation

E-Prime recorded HAT data for each participant. A total of 90 individual E-Prime data files were transferred into a specifically designed Microsoft Excel 2011 file which extracted the dependent variables. This information was subsequently entered into an SPSS version 20 file to complete the analysis (IBM Corporation, 2011). The data recorded from the participant self-report measures were combined with the HAT information. A participants self-report and HAT data were matched via the use of coding. This resulted in all data for each participant displayed in rows, with each variable in columns. Data inspection found all cases to be correct with no missing values.

Between-Groups Comparisons

Table 4 provides results from a one-way ANOVA examining a comparison of means of the sample characteristics from the self-report measures for all three groups. Specifically, analysis focuses on age, the total number of jobs held, total number of jobs held with an associated safety risk, the total number of hours of health and safety training/education, position and career industry tenure, weekly gaming console use and daily computer use. Post hoc contrasts were conducted using a Scheffe test indicating where the significant differences occurred. Inspection of Table 4 reveals that as expected, participants involved in the *high HSE group* have significantly more work experience, more work experience working with an associated safety risk, and more health and safety training/education. No significant differences were found in weekly gaming console use and daily computer use.

Table 4.

One-way ANOVA comparison of means between the three HSE groups on age, number of jobs held, number of jobs with safety risk, hours of health and safety training, job and career tenure, gaming console use and computer use.

Variable	Low HSE Group (1) M (SD) N=30	Medium HSE Group (2) M (SD) N=30	High HSE Group (3) M (SD) N=30	Comparison F (2,87) =	Contrasts. Scheffe Test
Age	20.8 (6.95)	26.1 (9.31)	41 (6.95)	54.041***	1 v 2* 2 v 3*** 3 v 1***
Number of jobs held	3 (2.03)	4.3 (2.61)	6.9 (2.94)	18.088***	1 v 2 n.s 2 v 3** 3 v 1***
Number of jobs with safety risk	1.3 (1.29)	2.83 (1.51)	3.97 (2.37)	16.850***	1 v 2** 2 v 3 n.s 3 v 1***
Hours of health and safety training/education	3.6 (6.48)	20.4 (9.33)	104 (111.36)	20.740***	1 v 2 n.s 2 v 3*** 3 v 1***
Position Tenure (Years)	.65 (.90)	2.19 (2.01)	4.08 (2.90)	19.918***	1 v 2* 2 v 3** 3 v 1***
Career Tenure (Years)	1.62 (2.47)	4.70 (5.67)	6.43 (4.54)	9.074***	1 v 2* 2 v 3 n.s 3 v 1***
Hours of gaming console use per week	5.43 (18.26)	1.7 (2.27)	.66 (1.89)	1.653 n.s	n.s
Hours of computer use per day	5.53 (3.25)	5.58 (3.67)	7.23 (2.01)	2.990 n.s	n.s

*** P<.000, ** P<.01, * P<.05, n.s = non-significant.

Table 5 conveys the results from a one-way ANOVA examining the means between all three groups on their self-reported accident and incident history data. Specifically, analysis focuses on near miss incidents, minor injuries requiring medical attention, and lost time injuries which have occurred throughout their entire career. Inspection of Table 5 reveals a significant difference on the number of near miss incidents. A post hoc contrast using a scheffe test indicated that the main effect was due to a significant difference between the *high HSE group* and *low HSE group*. This is to be as expected as it is consistent with self-report data on experience working within a job with an associated safety risk (see Table 4). No significant differences were found when comparing the minor injuries requiring medical attention, and the number of lost time injuries.

Table 5.

One-way ANOVA comparison of means between the three groups on self-reported near miss incidents, minor injuries requiring medical attention, and a lost time injury requiring time off from university or work.

	Low HSE Group (1) M(SD) N=30	Medium HSE Group (2) M(SD) N=30	High HSE Group (3) M(SD) N=30	Comparison F(2,87) =	Contrasts. Scheffe Test
Near miss incidents	9.06 (13.74)	33.50 (31.24)	74.33 (2.92)	6.177**	1 v 2 n.s 2 v 3 n.s 3 v 1 **
Minor injuries requiring medical attention	7.56 (8.35)	5.06 (4.82)	6.23 (6.23)	1.067 n.s	n.s
Lost time injuries	2.2 (2.92)	1.4 (1.95)	1.16 (1.34)	1.860 n.s	n.s

*** *P*<.000, ** *P*<.01, * *P*<.05, n.s = non-significant.

Table 6 provides the means, standard deviations and a one-way ANOVA between-groups comparison of the data collected from the 5 validated scales used in the self-report measures. Dashes in the table indicate that the measure was not included in the respective self-report measure and therefore comparisons are unavailable. An inspection of the means reveal that participants in all three groups provided on average, high scores on positive measures of safety (safety motivation and safety consciousness) and low scores on negative measures of safety (risk taking). These results are consistent with the suggestion that social desirability and impression management can influence responses on self-report scales A between-groups comparison revealed statistically significant differences present on the safety motivation, safety consciousness and risk taking scales. Specifically, post-hoc testing indicated that the *high HSE group* significantly differed to the *low HSE group* and *medium HSE group* on all 3 comparable safety scales. The mean scores on safety motivation and safety consciousness travelled in a positive, linear direction in relation to the groups assumed health and safety expertise. Likewise, the mean scores on risk taking travelled in a negative linear direction in relation to the groups assumed health and safety expertise. As expected, participants in the *medium HSE group* rated high on safety knowledge (maximum possible score = 5) indicating they are confident in performing their job in a safe manner. Additionally, the *high HSE group* rated high on career commitment (maximum possible score = 5), suggesting that the sample used are motivated and committed to their current position and career in health and safety management.

Table 6.

Comparison of self-report validated scale means between all three groups.

Variable	Low HSE Group (1) M (SD) N=30	Medium HSE Group (2) M (SD) N=30	High HSE Group (3) M (SD) N=30	Comparison F(2,87) =	Contrasts. Scheffe Test
Safety Motivation	4.49 (.45)	4.57 (.49)	4.92 (.14)	13.583***	1 v 2 n.s 2 v 3** 3 v 1***
Risk Taking	3.0 (.56)	2.97 (.68)	2.21 (.43)	18.700***	1 v 2 n.s 2 v 3*** 3 v 1***
Safety Consciousness	3.27 (.49)	3.26 (.41)	4.2 (.41)	35.409***	1 v 2 n.s 2 v 3*** 3 v 1***
Safety Knowledge	- -	4.44 (.44)	- -	-	-
Career Commitment	- -	- -	4.18 (.43)	-	-

*** *P*<.000, ** *P*<.01, * *P*<.05, n.s = non-significant.

Construct Validation of the HAT

In order to test hypothesis 1a and 1b, a one-way ANOVA was performed to examine the between group comparisons on the number of safety differences found on the HAT and the total time taken attempting to complete the HAT. Inspection of Table 7 indicates a significant difference between the three groups on the total number of safety differences found on the HAT. Specifically, the *low HSE group* significantly differed from the *medium HSE group* and *high HSE group*. Inspection of the means also reveal a positive linear trend with groups with the greater health and safety expertise identifying more safety differences. No significant differences were found between the three groups on the total time attempting to complete the HAT.

Table 7.

Comparison between all groups on the number of total safety differences found on the HAT

	Low HSE Group (1) M (SD) N=30	Medium HSE Group (2) M (SD) N=30	High HSE Group (3) M (SD) N=30	Comparison F (2,87) =	Contrasts. Scheffe Test
Number of safety differences found	43.63 (4.79)	46.12 (2.09)	46.56 (2.31)	6.046**	1 v 2** 2 v 3 n.s 3 v 1 **
Total time spent attempting to complete HAT (minutes)	15.02 (4.97)	15.93 (7.08)	15.23 (3.96)	.223 n.s	n.s

*** *P*<.000, ** *P*<.01, * *P*<.05, n.s = non-significant.

In order to test hypothesis 2a and 2b, all participants were divided into two groups determined by their self-reported responses on their workplace health and safety training involvement. The first group consisted of 68 participants who had received workplace health and safety training, with the second group consisting of 22 participants who indicated they had not received workplace health and safety training. A one-way ANOVA comparison was performed to examine HAT performance between the two groups. Inspection of Table 8 reveals a significant difference in the total number of safety differences found on the HAT. Participants who had received workplace health and safety training found more differences than participants who had not received workplace health and safety training suggesting that the HAT is a valid measure of hazard awareness. No significant difference was identified between the two groups in the total time spent attempting to complete the HAT.

Table 8.

One-way ANOVA comparison between groups consisting of participants who have received workplace health and safety training, and participants who have not received workplace health and safety training.

	Workplace has provided health and safety training to participant Mean (SD) N=68	Workplace has not provided health and safety training to participant Mean (SD) N=22	Comparison F (1,88)
Number of safety differences found on HAT	45.92 (2.60)	43.55 (5.03)	8.410**
Total time spent attempting to complete HAT	15.52 (5.44)	15.00 (5.56)	.149 n.s

*** *P*<.000, ** *P*<.01, * *P*<.05, n.s = non-significant.

In order to test hypothesis 3a and b, all participants were divided into two groups determined by their self-reported responses on whether they had undertaken health and safety education independent from their workplace. The first group consisted of 32 participants who indicated they had sought health and safety education outside of their work, with the second group consisting of 58 participants who indicated they had not sought out health and safety education outside of the workplace. A one-way ANOVA was performed to compare the total number of safety differences found on the HAT, and the total time spent attempting to complete the HAT. Inspection of Table 9 reveals that no significant differences were found between the two groups on HAT performance. However, an inspection of means indicate that although not significant, participants who had undertaken health and safety education independent from their workplace found more safety differences than those who had not undertaken workplace health and safety education from a provider independent from their workplace.

Table 9.

One-way ANOVA comparison on HAT metrics between participants who have undertaken health and safety education, and those who have not undertaken health and safety education.

	Have sought out health and safety education training undertaken outside of work. Mean (SD) N=32	Have not sought out health and safety training undertaken outside of work. Mean (SD) N=58	Comparison F (1,88)
Number of safety differences found on HAT	46.18 (2.23)	44.87 (3.95)	2.972 n.s
Total time taken attempting to complete HAT (seconds)	15.44 (3.93)	15.37 (5.99)	.004 n.s

*** *P*<.000, ** *P*<.01, * *P*<.05, n.s = non-significant.

In order to further test hypothesis 2a and 2b and 3a and 3b, all participants were divided into two groups determined by their self-report responses on whether they had received health and safety training provided by their workplace, and whether they had undertaken health and safety education independent from their workplace. The first group consisted of 32 participants who indicated they had received both workplace health and safety training and also undertaken health and safety education independent from their workplace. The second group consisted of 22 participants who indicated they had not received any form of workplace health and safety training, and had not undertaken health and safety education independent from their workplace. A one-way ANOVA was performed to compare the total number of safety differences found on the HAT, and the total time spent attempting to complete the HAT. Inspection of Table 10 reveals a significant difference on the number of safety differences found on the HAT between the two groups. As expected, participants who had received both health and safety training at work and sought out health and safety education outside of work found on average, more safety differences than participants who had not received any health and safety training at all. No significant difference was found on the total time taken attempting to complete the HAT.

Table 10.

One-way ANOVA comparison on HAT metrics between participants who have received health and safety training both at work and outside of work, and those who have not received any health and safety training at all.

	Have received health and safety training at work AND sought out health and safety education Mean (SD) N=32	Have not received any health and safety training or education at all Mean (SD) N=22	Comparison F (1,53)
Number of safety differences found on HAT	46.18 (2.23)	43.54 (2.23)	6.895*
Total time taken attempting to complete HAT	15.44 (3.93)	15.00 (5.56)	.116 n.s

*** *P*<.000, ** *P*<.01, * *P*<.05, n.s = non-significant.

Pearson Correlation Analysis

In order to test hypothesis 4, bivariate Pearson correlations were performed to examine the relationship between HAT performance metrics and self-report data on experience (total number of jobs held, and number with associated safety risk, position and career tenure) and health and safety training and education (total hours of health and safety training/education). Table 11 conveys the relationships between these sample characteristics of all participants and HAT performance metrics. Inspection of Table 11 reveals that statistically significant correlations exist in the relationships that the total number of safety differences found has with the total number of jobs held, number of jobs with an associated safety risk, tenure in the current position, and the hours of health and safety training and education. These relationships are consistent with the rationale that experience, training and education in occupational health and safety contribute to the knowledge of hazards, thus resulting in greater performance on the HAT. These results also support the construct validity of the HAT.

Table 11.

Pearson correlations between HAT metrics and participant sample characteristics measuring experience and health and safety training/education

	Total safety differences found on HAT	Total time spent attempting to complete HAT
Total number of jobs held	.23*	.12
Number of jobs with associated safety risk	.25*	.14
Tenure in current job position	.22*	.01
Tenure in current career industry	.09	.08
Hours of health and safety training/education	.20*[a]	-.08

*** *P*<.000, ** *P*<.01, * *P*<.05, [a] n= 88 after two outliers removed

A Pearson correlation matrix was produced which examined the relationships between HAT performance metrics, and self-reported validated safety scale scores across the entire sample. Specifically, HAT performance metrics were correlated with safety motivation, safety consciousness and risk taking. Results (see Table No significant relationships were found between self-reported scale responses and the total number of safety differences found on the HAT. Likewise, no significant relationships were found between self-reported scale responses and the total time taken attempting to complete the HAT. These relationships are consistent with the rationale that self-reported data has been subject to bias.

Table 12.

Pearson Correlation between HAT performance metrics and self-reported safety scale data across the entire sample

	Total safety differences found on the HAT N=90	Total time taken attempting to complete the HAT N=90
Safety Motivation	.028 n.s	.018 n.s
Risk Taking	.022 n.s	-.074 n.s
Safety Consciousness	.108 n.s	-.003 n.s

n.s = non-significant.

Additional Factors which may influence HAT Metrics

An investigation into additional factors which may influence performance on the HAT include an examination of gender, and previous experience using a computer or gaming console. Table 13 conveys the results from a one-way ANOVA examining gender differences on HAT performance metrics across the entire sample. This included a total of 47 males and 43 females. Inspection of Table 13 reveals no significant differences between genders. Table 14 provides Pearson correlations between HAT performance metrics and daily computer usage and weekly gaming usage. Inspection of Table 14 reveals that no significant relationships are present.

Table 13.

One-way ANOVA comparison examining HAT Metrics between males and females

HAT Metric	Male Mean (SD) N=47	Female Mean (SD) N=43	Comparison F(1,88) =
Total number of safety differences found	45.19 (4.08)	45.51 (2.71)	.188 n.s
Total time taken attempting to complete the HAT (minutes)	15.07 (5.66)	15.75 (5.24)	.348 n.s

n.s = non-significant.

Table 14.

Pearson Correlations between gaming and computer use and HAT metrics

	Total safety differences found on HAT N=90	Total time spent attempting to complete HAT N=90
Average hours per week using a gaming console	.07 n.s	.00 n.s
Average hours per week using a computer	.02 n.s	-.05 n.s

n.s = non-significant.

Discussion

The aim of this research was to investigate whether or not the Hazard Awareness Test (HAT) has construct validity. This process involved analyses into the differences in performance on the HAT in combination with the information provided in the self-report measures between three groups who differed in their experience and involvement in occupational health and safety. This validation process was conducted in order to address the need identified in the health and safety literature for an objective measure of safety which could be used during the recruitment process in selecting an applicant with hazard awareness.

Summary of Findings

In order to establish construct validity of the HAT, sample characteristics needed to be compared to ensure the samples were suitable for further analysis. As shown in Table 4, recruiting participants based on the quasi-variable of health and safety expertise proved to be effective as significant between-group differences existed in work experience, work experience with an associated safety risk, position and career tenure, and the total hours of health and safety training and education. Thus rendering appropriate samples to conduct a between groups analysis on HAT performance. Accident and incident frequency history data (see Table 5) proved a valuable resource so to observe consistencies with participants work history. For example, significant differences existed in the total number of near miss incidents between the three groups, which is consistent with the significant differences found (see Table 4) in a participants work experience in jobs with an associated safety risk. The rationale being that the more exposed an individual has to hazards, the greater potential for near miss incidents to occur.

Construct validity refers to the experimental demonstration that a test is measuring the construct it purports or claims to be measuring (Cronbach & Meehl, 1955). Such an experiment could take the form of a differential groups study, wherein differences in performance on the test is said to provide evidence of construct validity. The results across the measures just discussed clearly show that the groups varied in terms of safety and as such, varied in terms of hazard awareness. Given these results, if the HAT is a construct valid measure of hazard awareness it should be able to show between group differences. Therefore hypotheses 1a and 1b, 2a and 2b, 3a and 3b and 4 should be supported.

Hypotheses 1a and b address the influence that previous health and safety experience should have on HAT performance. It states that participants in the *high HSE group* will perform better on the HAT than the *medium HSE group* and *low HSE group* through the identification of a greater number of safety differences found, and taking less time attempting to complete the HAT. Results indicate that Hypothesis 1a is partially supported as a statistically significant difference is identified on the number of safety differences found between the *high HSE group* and the *low HSE group*. An observation of means (see Table 7) indicate a difference between the *high HSE group* and *medium HSE group*, however this difference is not statistically significant. As would be expected, a significant difference exists on the total number of safety differences found between the *medium HSE group* and the *low HSE group*. No support for Hypothesis 1b was found as no significant differences existed between groups on the total time taken attempting to complete the HAT. An observation of the means (see Table 7) indicates that the *low HSE group* took the least amount of time attempting to complete the HAT. This result could be explained by the limitations discussed on the total time taken attempting to complete the HAT variable.

Hypotheses 2a and 2b address the influence that previous health and safety training should have on HAT performance. It states that participants with health and safety training should perform better on the HAT in comparison to those who have not received workplace health and safety training. In order to test this, all participants were divided into two groups as determined by their response to health and safety training items in the self-report measure. Table 9 provides support to Hypothesis 2a as a significant difference is present in the number of safety differences found by participants who have received workplace health and safety training when compared to participants who had not received workplace health and safety training. As expected, participants who had received workplace health and safety training found more differences on average, than those who had not received workplace health and safety training. No support was found for Hypothesis 2b as no significant difference existed between the two groups on the total time taken attempting to complete the HAT. This result could be interpreted as those without workplace health and safety training having difficulty in finding the safety differences, thus choosing to 'give up' more quickly resulting in the HAT finishing with a lower time recorded.

Hypotheses 3a and 3b addresses the influence that previous health and safety education (undertaken independently from work) should have on HAT performance. It states that participants with health and safety education should perform better on the HAT in comparison to participants without health and safety education through the identification of a greater number of safety differences found, and taking less time attempting to complete the HAT. In order to test this, participants were divided into two groups dependent on their response to health and safety education items in the self-report measure. Results (see Table 10) indicate there is no significant difference between participants who have undertaken health and safety education when compared to participants who have not undertaken health and safety education. However, an observation of means provide partial support for hypothesis 3a as participants who have undertaken health and safety education found more differences on average than participants who have not undertaken health and safety education. Hypothesis 3b was not supported as no significant difference was found between the total time taken between the two groups. An observation of means indicate that those without health and safety education finish the HAT quicker, a result which could be explained by the limitations surrounding that variable.

Further support for hypothesis 2a and 3a is provided when participants are divided into two groups determined by their health and safety training (provided by their workplace) and health and safety education (undertaken independently from their workplace) responses on the self-report measure. Results (see Table 11) indicate a statistically significant difference is present between the two groups on the total number of safety differences found in the HAT. As expected, participants who have received both health and safety training and undertaken health and safety education identify a greater number of safety differences when compared with participants who have not received any form of health and safety training or health and safety education at all.

Hypothesis 4 addresses the prediction that if the HAT does contain construct validity, there should be significant positive correlations that exist across the entire sample between HAT performance metrics and the self-reported data involving participants work experience, health and safety training and health and safety education. Results (see Table 11) indicate that significant positive correlations exist between the total safety differences found on the HAT and a participant's total number of jobs held, number of jobs with associated safety risk, tenure in current position and the hours of health and safety training and education received. These significant relationships are consistent with the rationale that the awareness of hazards is something which is learned through work experience, health and safety training and health and safety education. Thus, these relationships are consistent with the HAT measuring hazard awareness. Also revealed in Table 11, no significant relationships were found between participant self-report data and the total time taken attempting to complete the HAT. This could be explained by the limitations discussed surrounding this variable.

Self-Report Bias

Although the HAT purports to measure hazard awareness, there is argument that other related safety constructs including safety motivation (Neal et al., 2000), safety consciousness (Westaby & Lee, 2003) and risk taking (Westaby & Lowe, 2005) should correlate with the total number of safety differences found on the HAT, and the total time taken attempting to complete the HAT. Specifically, it could be expected that measures of safety motivation and safety consciousness have a significant positive relationship with the total number of safety differences found on the HAT, and risk taking have a significant negative relationship with the total number of safety differences found. Additionally, it could be expected that measures of safety motivation and safety consciousness significantly negatively correlate with the total time taken attempting to complete the HAT, and risk taking have a positive relationship with the total time taken attempting to complete the HAT.

However, as per the rationale of the study, self-report data is subject to biases such as memory recall, social desirability and impression management as individuals tend to under-report behaviours deemed inappropriate by researchers or other observers, and they tend to over-report behaviours viewed as inappropriate (Moorman & Podaskoff, 1992). Therefore, it would be expected that significant correlations will not exist between self-reported data on validated scales of safety motivation, safety consciousness, and risk taking. Table 12 indicates no significant relationship between validated scales of safety and HAT performance metrics, thus suggesting that self-report data has been influenced by bias.

Practical and Theoretical Implications

Given the unfavourable statistics surrounding occupational accidents and fatalities it is important for organisations to hire personnel with the required hazard awareness in an attempt to reduce these outcomes. The results of this study suggest that the HAT is construct valid, that is, evidence suggests that the HAT does indeed measure an individual's hazard awareness. The practical implications of these findings suggest the HAT could be a solution to the problematic nature of safety measurement during the recruitment process in personnel selection, particularly within high risk industries.

Currently, organisations are utilising methods (e.g. accident and incident frequency information) and psychometric tools (e.g. HSI) which are difficult to interpret or are subject to biases such as impression management and social desirability. Job applicants understand that their responses to sensitive issues such as occupational health and safety will have a direct impact on how they are perceived by their prospective employer. As such, there is a strong need for an objective measure which can accurately capture a job applicants' hazard awareness. Organisations within high risk industries would benefit most from such an instrument given their requirement of filling positions with an associated safety risk. As highlighted in the study, participants with experience in jobs with an associated safety risk recorded a greater frequency of near miss incidents. Thus an individual's hazard awareness, or lack thereof, could be the difference between a near miss incident turning into a workplace accident or fatality.

An additional issue recruiters and organisations often face is determining the potential safety performance of applicants who have limited or no work experience, thus accident and history frequency information data is unavailable. This often arises when job applicants are coming straight from a tertiary or high school environment. In this situation, an organisation may benefit from using the HAT as it measures hazard awareness across 5 different life domains. Therefore, the HAT is an appropriate measure for individuals who lack previous work experience as safety orientation can be experienced and learned in non-occupational settings.

Limitations

A limitation of the study involves the *medium HSE group* who comprised of individuals working within a high risk industry. As outlined, New Zealand has 5 high risk industries which are frequently contributing to the unfavourable health and safety statistics; construction, manufacturing, agriculture, fisheries and forestry. However given the interest (or lack thereof) from different industries, the study group comprised of participants employed in construction n=14, manufacturing n=9, and agriculture n= 7 but no representation from fisheries or forestry. Future research could focus on improving the external validity of the study by ensuring that all 5 priority sectors are evenly assessed.

Another limitation of the study concerns the intended use of the HAT. The intended use of the HAT is for organisations to use on individuals applying for jobs, particularly in positions where safety performance is paramount such as in high risk industries. However, validation of the tool was completed using a sample who were knowingly participating in an experiment incentivised by low value monetary vouchers or university course credit. Therefore, participants completed the task where there were no real-life implications or consequences for their performance. It could be argued that results may be different if the tool was implemented on a sample during the recruitment phase of the selection process, where consequences of a poor performance could lead to the applicant being unsuccessful in being hired for a position.

A third limitation of the study related to the HAT performance metric, total time taken attempting to complete the HAT. The variable is used based on the rationale that individuals who have greater hazard awareness should spend less time in identifying the safety hazards on the HAT. However, this variable is questionable as it does not differentiate between participants who used all possible clicks (10) on the puzzle scene and participants who instead chose to click the ‘give up’ option. Possible explanations for a participant giving up could be due to the difficulty of a particular puzzle scene, or indicative of a personality trait such as perseverance which may have influenced how much a participant was prepared to spend looking for the final remaining differences. Another possible explanation could be time pressures with participants feeling rushed due to approaching commitments such as lectures or appointments affecting the total time taken attempting to complete the HAT. Regardless of a participant’s possible motives for ‘giving up’, the use of this variable as an indicator of greater performance should not be viewed independently. Instead, this variable should be viewed in combination with the total number of safety differences found.

Future Research

There is a lack of longitudinal research in workplace health and safety, specifically, very few safety related studies engage in repeat measurement over time (Chmiel, 2008; Neal & Griffin, 2006). Therefore future research could engage in longitudinal assessments to examine the test-retest reliability of the HAT providing insight into how consistent and stable the instrument is over a period of time. It would also be interesting to examine the predictive validity of the HAT. Therefore a longitudinal study which examined HAT performance whilst taking into account workplace accident and incident frequency data would prove beneficial.

Future research could look to include more HAT performance metrics. The HAT could benefit from the development of a new performance metric measuring the types of difference found first. Future research involving the HAT could look to include a variable which provides a quantifiable score surrounding the order in which the differences were found (safety differences v neutral differences). This variable could differentiate between participants with similar scores on the HAT. The rationale behind the development of a 'safety order' performance metric variable would be that individuals with greater hazard awareness would be more inclined on average, to find the safety differences first compared with neutral differences.

Conclusion

The purpose of this study was to examine whether the Hazard Awareness Test (HAT) is construct valid. All four hypotheses received support, thus providing evidence in support of the HAT measuring hazard awareness. The study contributes to the current literature on safety measures, in particular focusing on objective measures of safety which don't possess bias such as social desirability and impression management. The main limitation of the study is the 'total time taken attempting to complete the HAT' variable, however future research could look at viewing this variable in combination with the 'total number of safety differences found' variable. Overall, the results suggest that organisations particularly in high risk industries could benefit most from the implementation of the HAT in their selection battery in order to employ job applicants with the required hazard awareness, thus reducing the unfavourable health and safety statistics surrounding workplace accidents and fatalities.

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Appendix A

Low HSE Group Recruitment Advertisement

Study Information

Study Name	Safety Orientation Assessment
Study Type	**Standard (lab) study** This is a standard lab study. To participate, sign up, and go to the specified location at the chosen time.
Study Status	**Visible to participants:** Approved **Active study:** Appears on list of available studies
Duration	35 minutes
Credits	2 Credits
Abstract	Series of Spot the difference Puzzles (15-20 mins), short survey (5-10 mins) followed by debrief.
Description	The purpose of this project is to investigate the validity of a tool for use when recruiting employees into jobs which have associated safety risks. Your involvement in this project requires you to complete a set of 10 spot the difference puzzles on a computer based program followed by a short questionnaire. Note: The experiment will take place in Room 439 (4th floor) in the Psychology/Sociology Building.

Appendix B

Medium HSE Group Email

Organisation Name
Number Street name
Suburb
City Postcode
New Zealand

Dear Name,

I am contacting you as I need employees working within a high risk industry to participate in my thesis research. My thesis research is part of an ongoing project which is developing a computer based test of *safety orientation* which can be used by organizations when recruiting employees or assigning employees to training programs.

The *safety orientation* measure is a computer based test, which is generally completed in about 25 minutes. Participation would involve you completing the test, after which we would ask you to complete a short survey which is estimated to take no longer than 10 minutes.

If you agree to participate I will bring the test to you (on a laptop), at a time which is convenient to you. As a token of thanks we can provide you with a $10 MTA Fuel Voucher.

I would like to emphasise that the *safety orientation* test is being developed for real world application. As such we need data and feedback from the people that are working in high risk industries.

The results of the project may be published, but you can rest assured of the complete confidentiality of data gathered in this investigation. The identity of participants will not be made public. All data and participant information will be held in a locked cabinet accessed only by the primary supervisor.

The research project is being carried out under the primary supervision of Associate Professor Chris Burt. Chris can be contacted via email at christopher.burt@canterbury.ac.nz to discuss any concerns you may have surrounding your participation in the project. The project has been reviewed and approved by the University of Canterbury Human Ethics Committee.

If you are interested in participating or have any questions, please email myself at anton.thomas@pg.canterbury.ac.nz. Your participation would be very much appreciated.

Yours faithfully,

Anton Thomas

Appendix C

High HSE Group Email

Organisation Name
Number Street name
Suburb
City Postcode
New Zealand

Dear Name,

I am contacting you as I need experts in Health and Safety to participate in my Masters thesis research. My thesis research is part of an ongoing project which is developing a computer based test of *safety orientation* which can be used by organizations when recruiting employees or assigning employees to training programs.

The *safety orientation* measure is a computer based test, which is generally completed in about 25 minutes. Participation would involve you completing the test, after which we would ask you to complete a short survey which is estimated to take no longer than 10 minutes.

If you agree to participate I will bring the test to you (on a laptop), at a time which is convenient to you. As a token of thanks we can provide you with a $10 MTA Fuel Voucher.

I would like to emphasise that the *safety orientation* test is being developed for real world application. As such we need data and feedback from the people that are working in health and safety.

The results of the project may be published, but you can rest assured of the complete confidentiality of data gathered in this investigation. The identity of participants will not be made public. All data and participant information will be held in a locked cabinet accessed only by the primary supervisor.

The research project is being carried out under the primary supervision of Associate Professor Chris Burt. Chris can be contacted via email at christopher.burt@canterbury.ac.nz to discuss any concerns you may have surrounding your participation in the project. The project has been reviewed and approved by the University of Canterbury Human Ethics Committee.

If you are interested in participating or have any questions, please email myself at anton.thomas@pg.canterbury.ac.nz. Your participation would be very much appreciated.

Yours faithfully,

Anton Thomas

Appendix D

HAT Instructions

Safety Orientation Assessment Study

You will see two almost identical images side-by-side. Your task is to find the differences between the two displayed images.

There are a total of 10 DIFFERENCES in each puzzle.

At the beginning of each puzzle, the mouse cursor (+) will be in the bottom centre of the screen.

The Task

You have a total of 10 ATTEMPTS (mouse clicks) to find the differences.

Please move the computer mouse cursor over the difference on the RIGHT-HAND puzzle, and click on the difference with the left-hand mouse button.

If the difference is correct a green indicator box will be displayed. If an error occurs, the selected area will not be highlighted, and you will be able to try again.

It is important to place the middle of the mouse cursor (+) directly over the difference.

Once your 10 attempts to find the differences are completed you will be moved on to the next puzzle. If you are stuck and cannot find more differences, please choose “Give Up” to move onto the next puzzle.

Once you have moved on to the next puzzle, you won’t be able to return to previous puzzles.

Please repeat this process until all 10 puzzles have been completed

When you are ready to begin, please click the mouse button anywhere on the screen

Appendix E

Participant Information Sheet

Department of Psychology

INFORMATION SHEET

Safety Orientation Assessment

You are invited to participate in the research project titled *Safety Orientation Assessment.*

The purpose of this project is to investigate the validity of a tool for use when recruiting employees into jobs which have associated safety risks.

Your involvement in this project requires you to complete a set of 10 puzzles on a computer based program, and a short questionnaire

Your participation in this project is very much appreciated and will be rewarded with a $10 MTA Fuel Voucher.

The results of the project may be published, but you can rest assured of the complete confidentiality of data gathered in this investigation. The identity of participants will not be made public. All data and participant information will be held under direct responsibility of the primary supervisor.

The research project is being carried out in partial fulfilment of the requirements of a Master of Science in Applied Psychology by Anton Thomas under the primary supervision of Associate Professor Chris Burt. Chris can be contacted via email at christopher.burt@canterbury.ac.nz to discuss any concerns you may have surrounding your participation in the project.

The project has been reviewed and **approved** by the University of Canterbury Human Ethics Committee.

Appendix F

Participant Consent Form

Anton Thomas

Department of Psychology

CONSENT FORM

Safety Orientation Assessment

I have read and understood the description of the above-named project. On this basis, I agree to participate in the project, and I consent to publication of the results of the project with the understanding the anonymity will be preserved.

I understand also that I may at any time withdraw from the project, including withdrawal of any information I have provided, without penalty.

I note that the project has been reviewed and approved by the University of Canterbury Human Ethics Committee.

Signature: ....

Date: ....

Appendix G

Low HSE Group Self-Report Measure

Safety Orientation Assessment

Part 2 – Self Report Safety Questionnaire

Thank you for continuing to participate in this research. The second part of this study involves completing this safety questionnaire which contains questions on demographic information, work information, accident/incident reporting, safety expectations, risk taking and safety motivation.

It is estimated that this safety questionnaire will take **10 minutes** to complete.

It is important that you read each question carefully and answer all questions as honestly as you can. This research is reliant on your detailed attention and honesty in the answers you have provided.

It is important to note that the information you provide is strictly confidential and will not be seen by your company/supervisor or any other employees.

If you have any questions about this research, please contact Anton Thomas (researcher) aht29@uclive.ac.nz or Associate Professor Chris Burt (primary supervisor) on christoper.burt@canterbury.ac.nz.

To Begin, please turn the page.

For Official Use Only
Code to match with Puzzle ………..

Section 1: Demographic and Workplace Information

1. Age: ………
2. Gender (please circle) : Male Female
3. How many paid jobs have you held? …………………………………………………..
4. How many jobs have you held which you feel had an associated safety risk? ……
5. Do you currently hold employment in a paid position? (If No, go to Q10).…………
6. Your current Occupation/Job Title: ……………………………………...................
7. How long have you been employed in this position? Years …….. Months……......
8. How long you been employed in this industry? Years …….. Months…..........
9. Has your current place of work provided you with workplace health and safety training/information?..
10. Have you at any time been enrolled in a workplace health and safety program/course of study? If yes, please specify (provider, length of course) ....
   ....
   ....
11. Please indicate the **total number of hours** you would have spent learning about workplace health and safety (risk assessment, hazard identification etc). ………..
12. Please indicate the **average number of hours per day** you would spend using a computer/laptop? ……………………………………………………………………
13. Please indicate the **average number of hours per week** you would spend playing computer/console games? ………………………………………………………

Section 2: Safety Related Scales

For each of the three **accident and incidents categories** please indicate how many you have been involved with **over your entire life**

	Number of times
Near miss incidents, which had it turned out differently, could have resulted in injury or damage	
Minor injuries requiring medical attention (eg. first aid treatment or a visit to the doctor)	
Lost Time Injury (LTI) that has required you to take time off school/university/work	

For each statement, please circle the number which indicates the extent to which you disagree or agree.

	Strongly disagree	Disagree	Neither agree/ disagree	Agree	Strongly agree
I believe that workplace health and safety is an important issue	1	2	3	4	5
I feel that it is worthwhile to put in effort to maintain or improve my personal safety	1	2	3	4	5
I feel that it is important to maintain safety at all times	1	2	3	4	5
I believe that it is important to reduce the risk of accidents and incidents in the workplace	1	2	3	4	5
I always take extra time to do things safely	1	2	3	4	5
People think of me as being an extremely safety-minded person	1	2	3	4	5
I always avoid dangerous situations	1	2	3	4	5
I take a lot of time to do something safely even when it slows my performance	1	2	3	4	5
I often find myself making sure that other people do things that are safe and healthy	1	2	3	4	5

I get upset when I see other people acting dangerously	1	2	3	4	5
Doing the safest possible thing is always the right thing	1	2	3	4	5
I would rather take risks than be overly cautious	1	2	3	4	5
In the past month I have done some exciting things that others might find dangerous	1	2	3	4	5
I love to take risks even when there is a small chance I could get hurt	1	2	3	4	5
Sometimes people get on my nerves when they tell me how to act "more safely"	1	2	3	4	5
I value having fun more than being safe	1	2	3	4	5

Please check that all questions are completed.

Thank you for your time and participation in this research project.

Appendix H

Medium HSE Group Self-Report Measure

UNIVERSITY OF CANTERBURY
Te Whare Wānanga o Waitaha
CHRISTCHURCH NEW ZEALAND

Safety Orientation Assessment

Part 2 – Self Report Safety Questionnaire

Thank you for continuing to participate in this research. The second part of this study involves completing this safety questionnaire which contains questions on demographic information, work information, accident/incident reporting, safety expectations, safety knowledge, safety motivation and risk taking.

It is estimated that this safety questionnaire will take **10 minutes** to complete.

It is important that you read each question carefully and answer all questions as honestly as you can. This research is reliant on your detailed attention and honesty in the answers you have provided.

It is important to note that the information you provide is strictly confidential and will not be seen by your company/supervisor or any other employees.

If you have any questions about this research, please contact Anton Thomas (researcher) aht29@uclive.ac.nz or Associate Professor Chris Burt (primary supervisor) on christoper.burt@canterbury.ac.nz.

To Begin, please turn the page.

For Official Use Only
Code to match with Puzzle ………..

Section 1: Demographic and Workplace Information

14. Age: ………

15. Gender (please circle) : Male Female

16. How many paid jobs have you held? …………………………………………………..

17. How many jobs have you held which you feel had an associated safety risk? ……

18. Your current Occupation/Job Title: ……………………………………...................

19. How long have you been employed in this position? Years …….. Months……......

20. How long you been employed in this industry? Years …….. Months…..........

21. Has your current place of work provided you with workplace health and safety training/information? : Yes No

22. Independent from work, have you at any time been enrolled in a workplace health and safety program/course of study? If yes, please specify (provider, length of course)

    ……………………………………………………………………………….……...

    ……………………………………………………………………………………

23. Please indicate the **total number of hours** you would have spent learning about workplace health and safety (risk assessment, hazard identification etc). ………..

24. Please indicate the **average number of hours per day** you would spend using a computer/laptop? ………………………………………………………………………

25. Please indicate the **average number of hours per week** you would spend playing computer/console games? ……………………………………………………………

Section 2: Safety Related Scales

For each of the three **accident and incidents categories** please indicate how many you have been involved with **over your entire life**

	Number of times
Near miss incidents, which had it turned out differently, could have resulted in injury or damage	
Minor injuries requiring medical attention (eg. first aid treatment or a visit to the doctor)	
Lost Time Injury (LTI) that has required you to take time off school/university/work	

Please indicate how much you agree or disagree with each of these statements.

	Strongly disagree	Disagree	Neither agree/ disagree	Agree	Strongly agree
I believe that workplace health and safety is an important issue	1	2	3	4	5
I feel that it is worthwhile to put in effort to maintain or improve my personal safety	1	2	3	4	5
I feel that it is important to maintain safety at all times	1	2	3	4	5
I believe that it is important to reduce the risk of accidents and incidents in the workplace	1	2	3	4	5
I always take extra time to do things safely	1	2	3	4	5
People think of me as being an extremely safety-minded person	1	2	3	4	5
I always avoid dangerous situations	1	2	3	4	5
I take a lot of time to do something safely even when it slows my performance	1	2	3	4	5

I often find myself making sure that other people do things that are safe and healthy	1	2	3	4	5
I get upset when I see other people acting dangerously	1	2	3	4	5
Doing the safest possible thing is always the right thing	1	2	3	4	5
I would rather take risks than be overly cautious	1	2	3	4	5
In the past month I have done some exciting things that others might find dangerous	1	2	3	4	5
I love to take risks even when there is a small chance I could get hurt	1	2	3	4	5
Sometimes people get on my nerves when they tell me how to act "more safely"	1	2	3	4	5
I value having fun more than being safe	1	2	3	4	5
I know how to perform my job in a safe manner	1	2	3	4	5
I know how to use safety equipment and standard work procedures	1	2	3	4	5
I know how to maintain or improve workplace health and safety	1	2	3	4	5
I know how to reduce the risk of accidents and incidents in the workplace	1	2	3	4	5

Please check that all questions are completed.

Thank you for your time and participation in this research project.

Appendix I

High HSE Group Self-Report Measure

Safety Orientation Assessment

Part 2 – Self Report Safety Questionnaire

Thank you for continuing to participate in this research. The second part of this study involves completing this safety questionnaire which contains questions on demographic information, work information, accident/incident reporting, safety motivation, safety expectations, risk taking and commitment to your current career.

It is estimated that this safety questionnaire will take **10 minutes** to complete.

It is important that you read each question carefully and answer all questions as honestly as you can. This research is reliant on your detailed attention and honesty in the answers you have provided.

It is important to note that the information you provide is strictly confidential and will not be seen by your company/supervisor or any other employees.

If you have any questions about this research, please contact Anton Thomas (researcher) aht29@uclive.ac.nz or Associate Professor Chris Burt (primary supervisor) on christoper.burt@canterbury.ac.nz.

To Begin, please turn the page.

For Official Use Only
Code to match with Puzzle ………..

Section 1: Demographic and Workplace Information

26. Age: ………

27. Gender (please circle) : Male Female

28. How many paid jobs have you held? ………………………………………………..

29. How many jobs have you held which you feel had an associated safety risk? ……

30. Your current Occupation/Job Title: ……………………………………...................

31. How long have you been employed in this position? Years …….. Months……......

32. How long you been employed in this industry? Years …….. Months…..........

33. Has your current place of work provided you with workplace health and safety training/information? : Yes No

34. Independent from work, have you at any time been enrolled in a workplace health and safety program/course of study? If yes, please specify (provider, length of course)
…………………………………………………………………………………….……...
…………………………………………………………………………………………

35. Please indicate the **total number of hours** you would have spent learning about workplace health and safety (risk assessment, hazard identification etc). ………..

36. Please indicate the **average number of hours per day** you would spend using a computer/laptop? …………………………………………………………………………

37. Please indicate the **average number of hours per week** you would spend playing computer/console games? ……………………………………………………………

Section 2: Safety Related Scales

For each of the three **accident and incidents categories** please indicate how many you have been involved with **over your entire life**

	Number of times
Near miss incidents, which had it turned out differently, could have resulted in injury or damage	
Minor injuries requiring medical attention (e.g. first aid treatment or a visit to the doctor)	
Lost Time Injury (LTI) that has required you to take time off school/university/work	

Please indicate how much you agree or disagree with each of these statements.

	Strongly disagree	Disagree	Neither agree/ disagree	Agree	Strongly agree
I believe that workplace health and safety is an important issue	1	2	3	4	5
I feel that it is worthwhile to put in effort to maintain or improve my personal safety	1	2	3	4	5
I feel that it is important to maintain safety at all times	1	2	3	4	5
I believe that it is important to reduce the risk of accidents and incidents in the workplace	1	2	3	4	5
I always take extra time to do things safely	1	2	3	4	5
People think of me as being an extremely safety-minded person	1	2	3	4	5
I always avoid dangerous situations	1	2	3	4	5
I take a lot of time to do something safely even when it slows my performance	1	2	3	4	5
I often find myself making sure that other people do things that are safe and healthy	1	2	3	4	5
I get upset when I see other people acting	1	2	3	4	5

dangerously					
Doing the safest possible thing is always the right thing	1	2	3	4	5
I would rather take risks than be overly cautious	1	2	3	4	5
In the past month I have done some exciting things that others might find dangerous	1	2	3	4	5
I love to take risks even when there is a small chance I could get hurt	1	2	3	4	5
Sometimes people get on my nerves when they tell me how to act "more safely"	1	2	3	4	5
I value having fun more than being safe	1	2	3	4	5

Section 3: Career Commitment

These statements refer to ***commitment towards your current career.*** Please indicate how much you agree or disagree with each of these statements.

	Strongly disagree	Disagree	Unsure	Agree	Strongly Agree
I like this career too well to give it up	1	2	3	4	5
If I could go into a different profession which paid the same, I would probably take it	1	2	3	4	5
If I could do it all over again, I would not choose to work in this profession	1	2	3	4	5
I definitely want a career for myself in this profession	1	2	3	4	5
If I had all the money I needed without working, I would probably still continue working in this profession	1	2	3	4	5
I am disappointed that I ever entered this profession	1	2	3	4	5
This is the ideal profession for a life's work	1	2	3	4	5

Section 4: Feedback

Given your expertise, your feedback would be very much appreciated. Please answer each question honestly.

1. Please indicate how difficult you found the safety orientation measure

   1 2 3 4 5

   Very easy Easy Moderate Hard Very hard

2. How useful do you believe this tool could be in the process of recruiting employees for an organisation?

   1 2 3 4 5

   Not at all Useful Extremely useful

3. Other comments or feedback?..

   ....

   ....

   ....

   ....

Please check that all questions are completed.

Thank you for your time and participation in this research project.

Appendix J

Participant Verbal and Written Debrief

Department of Psychology

Safety Orientation Assessment

Debriefing Information

Thank you for your participation in the study.

This study was concerned with investigating whether or not the 'spot the difference puzzles' could be used as a valid measure of determining an individuals' safety orientation, specifically, hazard awareness. This is important as it may provide some practical value for an organisation during the recruitment phase, the idea being that if you can predict job applicants who are safe, you may be able to reduce the number of workplace accidents and fatalities.

In order to demonstrate the construct validity of the proposed safety orientation measure, it was important to conduct an experiment which assessed subjects who had differing health and safety expertise. Participants have been divided into three groups; Group 1 (Health and Safety Specialists), Group 2 (High Risk Industry Workers) and Group 3 (Students).

The hypothesis proposes that if the safety orientation measure has construct validity, participants who have greater health and safety expertise will perform better than those with lower expertise. Performance is measured through identification of safety differences (there was 5 safety and 5 neutral in each puzzle), and completing the puzzles in less time. Therefore it is predicted that Group 1 should outperform Group 2 and 3, and Group 2 should outperform Group 3.

In addition, if the safety orientation measure has construct validity, there will be significant relationships between the performance on the safety orientation measure and the validated safety related scales which were part of the self-report measure.

The results of the project may be published, but you can be assured of the complete confidentiality of the data gathered. Please remember you may withdraw from the study at any stage without penalty.

The research project is being carried out in partial fulfilment of the requirements of a Master of Science in Applied Psychology by Anton Thomas under the primary supervision of Associate Professor Chris Burt. Chris can be contacted via email at christopher.burt@canterbury.ac.nz to discuss any concerns you may have surrounding your participation in the project.

The project has been reviewed and **approved** by the University of Canterbury Human Ethics Committee
Thank you again for your participation.